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PATENT ABSTRACTS OF JAPAN

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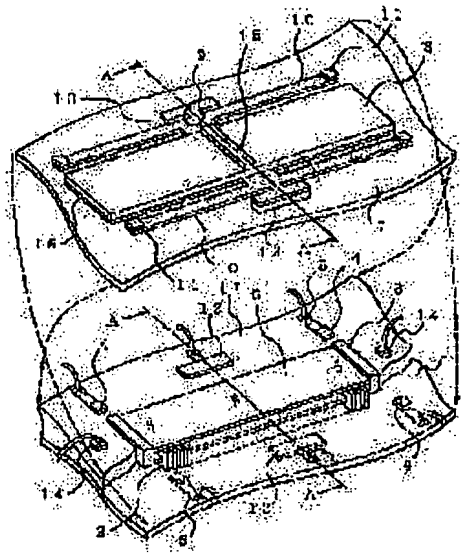
IDE TATSUMI

(54) ELECTROMAGNETIC RELAY AND MANUFACTURE OF THE SAME

(57)Abstract:
PROBLEM TO BE SOLVED: To reduce mounting space and to realize thinning and miniaturization by arranging an insulating substrate having a relay driving part and a fixed contact and an insulating substrate, having a relay movable part having a movable spring so that they are faced to each other.
SOLUTION: A relay driving part composed of a U-shaped core 3, a coil 2 formed by spirally connecting a plurality of a plate-shaped coil parts in the central part of the core 3, an insulating layer 17 formed on the peripheries of the coil 2 and the core 3, a coil terminal 14 connected to the coil 2, a hinge spring connecting part 12, a fixed contact 4 and an outer terminal pad 5 which are arranged on a movable contact 11 to face each other, and a magnet 6 above the coil 2 is arranged on one main surface of a first insulating substrate 1. An armature 8 having a rotational support part 15 and a hinge spring support pad 13 fixed to the armature 8 and for fixing a movable contact spring 10 having the movable contact 11 via a hinge spring 9 are formed on a second insulating substrate 7. By making these two insulating substrates 1, 7 face and join to each other, a very thin relay is formed.



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CLAIMS

[Claim(s)]
[Claim 1] The electromagnetic relay characterized by having the 1st insulating substrate which has arranged the relay mechanical component and stationary contact which consist of a coil, a core, and a magnet on 1 principal plane, and the 2nd insulating substrate which has stationed the relay moving part having the movable spring which prepared amateur and a traveling contact on 1 principal plane, and opposing said both 1 principal planes of said 1st and 2nd insulating substrates.
[Claim 2] Said 1st and 2nd insulating substrates are electromagnetic relays according to claim 1 which have stationed said relay mechanical component and said relay moving part in the shape of a same number [every] array, respectively.
[Claim 3] Said 1st and 2nd insulating substrates are claim 1 packed by covering or an electromagnetic relay according to claim 2.
[Claim 4] The coil which connects two or more tabular coil sections prepared in the center section of the horseshoe-shaped core in the shape of a spiral, and is formed, The end-winding child linked to said coil, the connection for hinge springs, and a stationary contact, The 1st insulating substrate which has arranged the external terminal pad connected to said connection for hinge springs and said stationary contact on 1 principal plane, It has the 2nd insulating substrate in which the hinge spring support pad for fixing the traveling contact spring which fixed to the amateur who formed the rotation supporter, and said amateur, and equipped both ends with the traveling contact through a hinge spring was formed on the 1 principal plane. between the side sections of said core -- and the electromagnetic relay characterized by having arranged the magnet for carrying out bias of said amateur's seesaw balance above said coil, and opposing said both 1 principal planes of said 1st and 2nd insulating substrates to it.
[Claim 5] Said 1st and 2nd insulating substrates are electromagnetic relays according to claim 4 which were equipped with two or more relay moving part, and said relay moving part and relay mechanical component of the same number, respectively, and have been arranged in the shape of an array.
[Claim 6] Said 1st and 2nd insulating substrates are claim 4 packed by covering or an electromagnetic relay according to claim 5.
[Claim 7] The process which creates the relay base which carried the magnet and contained the relay mechanical component after carrying out sequential formation of a coil pars basilaris ossis occipitalis, a core center section, the coil side section, the coil upper part, and the core yoke section and forming a stationary contact and a hinge spring connection on the 1st insulating substrate, After forming a hinge spring support pad and a sacrifice layer on the 2nd insulating substrate, By forming a silicon layer and a traveling contact spring on said sacrifice layer, forming amateur on said silicon layer further, and carrying out etching processing of the

appropriate account sacrifice layer of back to front The manufacture approach of the electromagnetic relay characterized by including the process which forms contact Brock as relay moving part as it can carry out movable [of said amateur and the traveling contact spring], and the process attached so that said 2nd insulating substrate may be made to counter said 1st insulating substrate.
[Claim 8] The coil pars-basilaris-ossis-occipitalis creation process which forms the tabular coil lower limit section on the 1st insulating substrate, The core center-section creation process which insulates with flattening and forms a core center section on said tabular coil lower limit section, The coil side section creation process which forms the tabular coil side section which follows said tabular coil lower limit section while maintaining an insulation to said core center section, The coil up formation process which forms the tabular coil upper limit section which follows said tabular coil side section so that it may become spiral-like, maintaining an insulation to said core center section, The core yoke section formation process which forms the core yoke section in the both ends of said core center section while maintaining the insulation with each part of said tabular coil is included. After forming a stationary contact and a hinge spring connection and forming a relay mechanical component on said 1st insulating substrate, between said core yoke sections — and the manufacture approach of the electromagnetic relay characterized by carrying the 2nd insulating substrate in which the relay moving part which has arranged the magnet above said tabular coil upper limit section, and had amateur and a movable spring was formed.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the electromagnetic relay which has a seesaw balance mold magnetic circuit, and its manufacture approach about an electromagnetic relay and its manufacture approach.
[0002]
[Description of the Prior Art] Conventionally, such a relay is one of the elements with important miniaturizing the size of the relay [itself] by the demand to the miniaturization of the equipment to mount, i.e., the demand of high density assembly.
[0003] The miniaturization of relay size is attained by detailed-izing of press working of sheet metal to the piece of each which constitutes a relay, reduction of the dead space by duplex mold molding of a coil, or reduction of the coil volume by magnetic high-performance-izing to the demand on such mounting. However, it does not pass over these manufacture approaches or relay structure to the conventional relay and design matter-amelioration of the manufacture approach, but there is a limitation in the further miniaturization.
[0004] For this reason, the further miniaturization of a relay is aimed at and the structure which introduced a part of semi-conductor process technique into manufacture of a relay is also

proposed. Such a proposal is introduced to "The NEW Generation Telecom Relay" etc. indicated by p14-1-p14-8 of the international society magazine "Proc. 46th Relay Conf.1998" about a relay manufacturing technology as an owner pole seesaw balance actuation form relay.
[0005] Drawing 6 is the decomposition perspective view of an electromagnetic relay showing a conventional example. As shown in drawing 6 , while this relay fixes the insulator pedestal 30 called the carrier which implanted the stationary-contact terminal 38, the end-winding child, etc., and the traveling contact spring 35 and the hinge spring 34 in the base section 36 It has the wrap covering 33 for the relay moving part 31 having a magnet 37, the plane coil 32 formed in Taira and others as a relay mechanical component, and the whole, and after equipping the insulator pedestal 30 with the relay moving part 31 and the plane coil 32, it is covered and formed with covering 33.
[0006] The traveling contact system in this relay is creating the base section 36 which supports the movable spring 35, the hinge spring 34, a traveling contact (it forms at the tip of the movable spring 35), and these by the conventional press technique, mold processing, etc. On the other hand, the drive system is creating the plane coil 32 with which a coil line pattern is wound in the same side using a semi-conductor process technique.
[0007]
[Problem(s) to be Solved by the Invention] Even if the conventional electromagnetic relay mentioned above uses the latest technique for a part in order to still create a traveling contact system with a machining technique, it has the fault that a dimension comparable as the present condition becomes a limitation.
[0008] moreover, if it sees about a drive system, in order to secure a field of operation, the substrate which forms a coil must be further alike, many coil patterns must be created, and there is a fault of needing coil occupancy area greatly. Although a miniaturization can be attained in the height direction to be sure, there is a problem that the mounting tooth space as the whole cannot be made small.
[0009] The purpose of this invention is to offer the electromagnetic relay which can also attain simplification of assembly operation, and equalization of a relay property, and its manufacture approach while it makes a mounting tooth space small and realizes high density assembly.
[0010]
[Means for Solving the Problem] The electromagnetic relay of this invention has the 1st insulating substrate which has arranged the relay mechanical component and stationary contact which consist of a coil, a core, and a magnet on 1 principal plane, and the 2nd insulating substrate which has stationed the relay moving part having the movable spring which prepared amateur and a traveling contact on 1 principal plane, opposes said both 1 principal planes of said 1st and 2nd insulating substrates, and is constituted.
[0011] Moreover, these 1st and 2nd insulating substrates can station said relay mechanical component and said relay moving part in the shape of a same number [every] array, respectively, and can form them.
[0012] Moreover, package formation of these 1st and 2nd insulating substrates is carried out with covering.
[0013] Furthermore, the coil which the electromagnetic relay of this invention connects two or more tabular coil sections prepared in the center section of the horseshoe-shaped core in the shape of a spiral, and is formed, The end-winding child linked to said coil, the connection for hinge springs, and a stationary contact, The 1st insulating substrate which has arranged the external terminal pad connected to said connection for hinge springs and said stationary contact on 1 principal plane, It has the 2nd insulating substrate in which the hinge spring support pad for fixing the traveling contact spring which fixed to the amateur who formed the rotation supporter, and said amateur, and equipped both ends with the traveling contact through a hinge spring was formed on the 1 principal plane. between the side sections of said core — and the magnet for carrying out bias of said amateur's seesaw balance above said coil is arranged, said both 1 principal planes of said 1st and 2nd insulating substrates are opposed, and it is constituted.
[0014] Moreover, these 1st and 2nd insulating substrates are equipped with two or more relay moving part, and said relay moving part and relay mechanical component of the same number,

respectively, are arranged in the shape of an array, and are formed.
[0015] Moreover, package formation of these 1st and 2nd insulating substrates is carried out with covering.
[0016] Furthermore, the manufacture approach of the electromagnetic relay of this invention carries out sequential formation of a coil pars basilaris ossis occipitalis, a core center section, the coil side section, the coil upper part, and the core yoke section on the 1st insulating substrate. The process which creates the relay base which carried the magnet and contained the relay mechanical component after forming a stationary contact and a hinge spring connection, After forming a hinge spring support pad and a sacrifice layer on the 2nd insulating substrate, By forming a silicon layer and a traveling contact spring on said sacrifice layer, forming amateur on said silicon layer further, and carrying out etching processing of the appropriate account sacrifice layer of back to front It is constituted including the process which forms contact Brock as relay moving part as it can carry out movable [of said amateur and the traveling contact spring], and the process attached so that said 2nd insulating substrate may be made to counter said 1st insulating substrate.
[0017] Furthermore, the coil pars-basilaris-ossis-occipitalis creation process that the manufacture approach of the electromagnetic relay of this invention forms the tabular coil lower limit section on the 1st insulating substrate, The core center-section creation process which insulates with flattening and forms a core center section on said tabular coil lower limit section, The coil side section creation process which forms the tabular coil side section which follows said tabular coil lower limit section while maintaining an insulation to said core center section, The coil up formation process which forms the tabular coil upper limit section which follows said tabular coil side section so that it may become spiral-like, maintaining an insulation to said core center section, The core yoke section formation process which forms the core yoke section in the both ends of said core center section while maintaining the insulation with each part of said tabular coil is included. between said core yoke sections after forming a stationary contact and a hinge spring connection and forming a relay mechanical component on said 1st insulating substrate — and a magnet is arranged above said tabular coil upper limit section, and the 2nd insulating substrate in which the relay moving part having amateur or a movable spring was formed is carried, and it is constituted.
[0018]
[Embodiment of the Invention] Next, the gestalt of operation of this invention is explained with reference to a drawing.
[0019] Drawing 1 is a perspective view of relay moving part and a relay mechanical component which forms the electromagnetic-relay principal part for explaining the gestalt of 1 operation of this invention. As shown in drawing 1 , the electromagnetic relay in the gestalt of this operation has the seesaw balance mold magnetic circuit which drives the traveling contact spring 10 which has a traveling contact 11, and this traveling contact spring 10, and manufactures the pieces of each and assembly other than magnet 6 using a semi-conductor process technique, i.e., a membrane formation technique. Especially, the coil of a coil 2 accomplishes tabular [much more], and is coiled in the direction perpendicular to the thickness direction of an insulating substrate 1. In addition, an insulating substrate 1 expresses a top-face side, and the insulating substrate 7 expresses the rear-face side.
[0020] This relay has arranged the coil 2, the core 3, the stationary-contact 4 external terminal pad 5, and the magnet 6 on one insulating substrate 1, and has formed amateur 8, the hinge spring 9, the traveling contact spring 10, the traveling contact 11, and the hinge spring support pad 13 on the insulating substrate 7 of another side. Moreover, to these, since the hinge spring 9 and the traveling contact spring 10 are formed in the SHIRINKON layer 16 and one, they arrange a conductor layer (illustration abbreviation) in order to make resistance low. Furthermore, these two insulating substrates 1 and 7 form a very thin relay by carrying out opposite junction.
[0021] Moreover, the coil 2 of the relay in the gestalt of this operation is given to the perimeter of a core 3 as a tabular coil for one layer, and is rolled in the perpendicular direction in the shape of a spiral (spiral) through the insulating layer to the thickness direction of an insulating substrate 1.

[0022] For this reason, the gestalt of this operation enable improvement in the magnetic effectiveness by anomaly-izing of the character type core 3 of KO, minimum-izing of the volume by make a coil coil tabular at the longitudinal direction of a core 3, and detailed-ization of amateur structure by adopt a semi-conductor process technique in the owner pole type seesaw balance magnetic circuit know for the conventional mechanical relay. Consequently, a micro relay is realizable.
[0023] Specifically, according to the gestalt of this operation, here where the volume realizes a relay of the 0.07 cube cm (= 6x4x3mm) is made to that whose volume is 0.55 cube cm (= 10.6x5.8x9.0mm) extent being the smallest in the latest present press and the owner pole type seesaw balance magnetic-circuit relay which made full use of a mold technique.
[0024] Although the above explained the outline of the relay in the gestalt of this operation In short, the gestalt of this operation on the 1 principal plane of the 1st insulating substrate 1 The horseshoe-shaped core 3, While being formed on the coil 2 which connects two or more tabular coil sections prepared in the center section of this horseshoe-shaped core 3 in the shape of a spiral, and is formed, the insulating layer 17 formed in the perimeter of these coils 2 or a core 3, and this insulating layer 17 The end-winding child 14 linked to a coil 2, and the connection 12 for hinge springs, The external terminal pad 5 connected to the stationary contact 4 made [a traveling contact 11] to carry out opposite arrangement, and the connection 12 for these hinge springs and a stationary contact 4 is arranged. Moreover, the hinge spring support pad 13 for fixing to the amateur 8 who formed the rotation supporter 15 on the 1 principal plane of the 2nd insulating substrate 7, and this amateur 8, and fixing the traveling contact spring 10 equipped with the traveling contact 11 to both ends through the hinge spring 9 is formed. and between the side sections of a core 3 -- and the relay is formed by arranging the magnet 6 for carrying out bias of amateur's 8 seesaw balance above a coil 2, and opposing both the 1 principal planes of two insulating substrates 1 and 7 to it.
[0025] Drawing 2 is an expanded sectional view near [in drawing 1] the hinge spring. Although the conductor layer mentioned above here is omitted as shown in drawing 2 , the silicon layer 16 of relay moving part is created by the hinge spring 9, the traveling contact spring 10, and one. In addition, although the sacrifice layer mentioned above was located in the space of the silicon layer 16 and an insulating substrate 7, in order to guarantee rotation movement of amateur 8 or the traveling contact spring 10, it is removed by etching.
[0026] Drawing 3 is a perspective view in the condition of having expressed typically the electromagnetic-relay moving part and the relay mechanical component for explaining the gestalt of other operations of this invention. As shown in drawing 3 , the gestalt of this operation is set in the gestalt of this operation. The insulating substrate 7 which has stationed the relay moving part 18 having the movable spring which prepared the amateur and traveling contact which are shown in above-mentioned drawing 1 in the shape of an array on 1 principal plane, It has the insulating substrate 1 which has arranged the relay mechanical component 19 which prepared the coil shown in above-mentioned drawing 1 , the core, and a magnet and a stationary contact on 1 principal plane in the shape of an array, and both the 1 principal planes of these insulating substrates 1 and 7 are opposed. In addition, arrangement of the shape of this array may be started as a relay which may arrange in the shape of a single-tier rod, and became independent one by one. Thus, if many relays are formed in one insulating substrate, high density assembly will be realized further.
[0027] Furthermore, in addition to a switch function, the control circuit of a current or an electrical potential difference is realizable by forming diode and a transistor on these insulating substrates 1 and 7 at coincidence, or carrying.
[0028] a part of condition that drawing 4 package-ized the relay shown in drawing 1 or drawing 3 -- it is a notch perspective view. As shown in drawing 4 , one electromagnetic relay or an electromagnetic-relay array can be formed by covering what formed facing each other, one, or two or more relay device sections for two insulating substrates 1 and 7 mentioned above with the package covering 20.
[0029] Moreover, this package-ization is also realizable with covering currently performed from the former, and resin mold.

[0030] Next, the manufacture approach of the electromagnetic relay of this invention is explained using drawing 1 and drawing 2 which mentioned the overall process above, and, subsequently a coil and the concrete production process of a core are explained with reference to drawing 5 .

[0031] First, as shown in drawing 1 and drawing 2 , about a relay mechanical component, the lower part of a coil 2 is formed with etching or plating with aluminum (aluminum) etc. on an insulating substrate 1, and the idiosoma of a core 3 is formed with magnetic-substance ingredients, such as Fe or Fe-nickel, through an insulating layer on it. Subsequently, the side section of a coil 2 is formed. Furthermore, after preparing an insulating layer in the top face of the idiosoma of a core 3, the upper part of a coil 2 and the York section of a core 3 are formed. The stationary-contact loading section, the external terminal pad 5, and the hinge spring connection 12 are formed on the insulating layer 17 formed of two or more insulating layers mentioned above after an appropriate time, and a stationary contact 4 is put on said stationary-contact loading section. Furthermore, the insulating layer 17 formed in the top face of the upper part of a coil 2 is dug deep, and the relay base which attached the magnet 6 and contained the relay mechanical component between both the magnetic pole sections of the York section of a core 3 is created.

[0032] Moreover, about relay moving part, the hinge spring support pad 13 and the sacrifice layer finally removed by etching etc. are formed on another insulating substrate 7. In the support pad 13, this sacrifice layer is in the same field, and is formed in the field to which amateur, a movable spring, etc. are moreover arranged. On this sacrifice layer, the silicon layer 16, the traveling contact spring 10, and an amateur joint (a part for the joint of amateur and a traveling contact spring) are formed with silicon (Si) etc., and laminating formation of the hinge spring 9 is carried out on the hinge spring support pad 13 at these and one. Furthermore, in order that even the hinge spring support pad 13 may secure the flow from the traveling contact 11 to the hinge spring 9 from a traveling contact 11 to the traveling contact spring 10 bottom through the traveling contact spring 10, a conductor layer (illustration abbreviation) is formed with aluminum etc. Subsequently, laminating formation of the amateur 8 is carried out with magnetic-substance ingredients, such as Fe or Fe-nickel, on the silicon layer 16. Furthermore, a traveling contact 11 is formed at the tip of the traveling contact spring 10. Then, as etching processing of the sacrifice layer is carried out and it can carry out movable [of amateur 8 and the traveling contact spring 10], contact Brock as relay moving part is formed.

[0033] Furthermore, after attaching so that the contact side insulating substrate 7 may be made to counter the base side insulating substrate 1, the external terminal strapping pad 5 is wired. In addition, this wiring may be before attachment of both the substrates 1 and 7.

[0034] The above is the overall production process of the electromagnetic relay in the gestalt of this operation, and explains a coil and the concrete production process of a core below.

[0035] Drawing 5 (a) - (e) is drawing showing the top face of the coil shown in order of the process for explaining the gestalt of 1 implementation of the manufacture approach of the electromagnetic relay of this invention, respectively, and a core, and a side cross section. First, as shown in drawing 5 (a), at a coil pars-basilaris-ossis-occipitalis creation process, coil lower 2A is formed on an insulating substrate 1 at a dimension predetermined with aluminum etc. In this case, a predetermined dimension is determined by coil resistance, an impression electrical potential difference, and the amount of generating fields. Although that formation approach forms the pattern of a thin film beforehand, it may be formed by plating or the spatter also out of this at predetermined thickness. Moreover, this coil lower 2A forms the charge of a coil strip of predetermined thickness in the whole creation range of a coil, and may remove a garbage by etching.

[0036] Subsequently, by the core idiosoma creation process, as shown in drawing 5 (b), in order to secure the insulation of coil lower 2A and core center-section 3A, after covering coil lower 2A by the insulating layers 21, such as diacid-ized silicon, it is on the insulating layer, and approaches, such as vacuum evaporationo and a spatter, are used above coil lower 2A, and core center-section (idiosoma) 3A is formed with magnetic-substance ingredients, such as Fe or Fe-nickel.

[0037] Subsequently, at a coil side section creation process, as shown in drawing 5 (c), in order to secure an insulation of a coil and a core similarly, core center-section 3A formed by drawing 5 (b) is once covered by the insulating layer 21 and the same insulating layer 22. Then, in order to grow up coil lower 2A to coil side section 2B with the same ingredient, coil lower 2A is exfoliated by etching in a part of wrap insulating layer 21, and coil side section 2B is formed in the part which exfoliated by the same approach as coil lower 2A.
[0038] As shown in drawing 5 (d) after an appropriate time, in a coil up formation process, it continues at coil side section 2B, and coil up 2C is formed by the same approach.
[0039] Furthermore, with a core yoke section formation process, as shown in drawing 5 (e), in order to secure an insulation of a coil and a magnet, coil up 2C is covered by the insulating layer 23. Then, in order to grow up core yoke section 3B from the both ends of core center-section 3A, it exfoliates by etching in a part of insulating layers 21 and 22 which have covered the both ends of core center-section 3A, and core yoke section 3B is formed by the same approach as core center-section 3A. Then, the magnet separately created among core yoke section 3B is arranged. Although this magnet took the approach of post-installing as bulk components in consideration of cost, the engine performance, etc., of course, it may be created using membrane formation techniques, such as vacuum evaporationo and etching.
[0040] Although it is the production process of the coil used as a part for the principal part of the relay mechanical component formed in an insulating-substrate 1 side, and a core, about the relay moving part formed in an insulating-substrate 7 side, the above may be formed as explained using above-mentioned drawing 1 and drawing 2 , or can also be separately formed independently.
[0041]
[Effect of the Invention] As explained above, by carrying out laminating formation of relay moving part and the relay mechanical component at a respectively different insulating substrate, and carrying out opposite arrangement of them, the electromagnetic relay and its manufacture approach of this invention are a thin shape, and effective in the ability to miniaturize size.
[0042] Moreover, this invention is effective in high density assembly being realizable by arranging the relay moving part and the relay mechanical component of the same number to each insulating substrate.
[0043] Furthermore, by forming a coil and a core using a semi-conductor membrane formation technique, this invention can simplify assembly operation and is effective in the ability to equalize a relay property while it makes spiral connection of two or more coil parts which made the coil tabular [of one layer].

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the perspective view of relay moving part and a relay mechanical component which forms the electromagnetic-relay principal part for explaining the gestalt of 1 operation of

this invention.
[Drawing 2] It is an expanded sectional view near [in drawing 1] the hinge spring.
[Drawing 3] It is a perspective view in the condition of having expressed typically the electromagnetic-relay moving part and the relay mechanical component for explaining the gestalt of other operations of this invention.
[Drawing 4] a part of condition of having package-ized the relay shown in drawing 1 or drawing 3 — it is a notch perspective view.
[Drawing 5] It is drawing which expressed the coil for explaining the gestalt of 1 implementation of the manufacture approach of the electromagnetic relay of this invention, the top face of a core, and the side cross section in order of the process.
[Drawing 6] It is the decomposition perspective view of an electromagnetic relay showing a conventional example.
[Description of Notations]
1 Seven Insulating substrate
2 Coil
2A Coil lower part
2B Coil side section
2C Coil upper part
3 Core
3A Core center section
3B Core yoke section
4 Stationary Contact
5 External Terminal Pad
6 Magnet
8 Amateur
9 Hinge Spring
10 Traveling Contact Spring
11 Traveling Contact
12 Hinge Spring Connection
13 Hinge Spring Support Pad
14 End-Winding Child
15 Rotation Supporter
16 Silicon Layer
17, 21, 22, 23 Insulating layer
18 Relay Moving Part
19 Relay Mechanical Component
20 Package Covering

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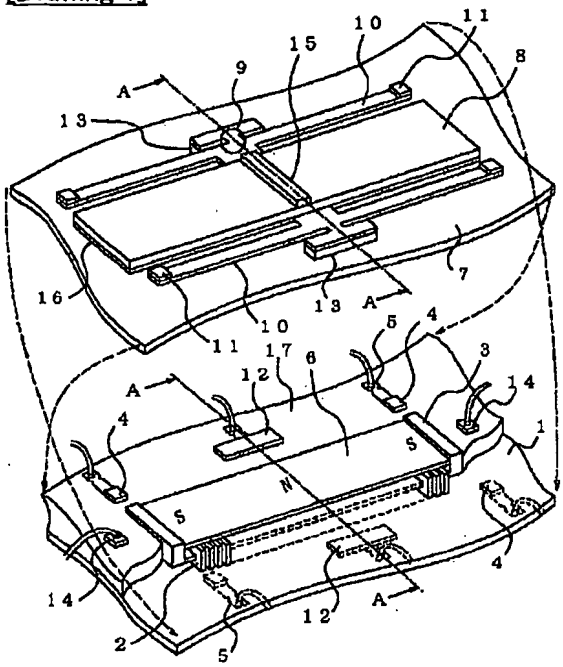
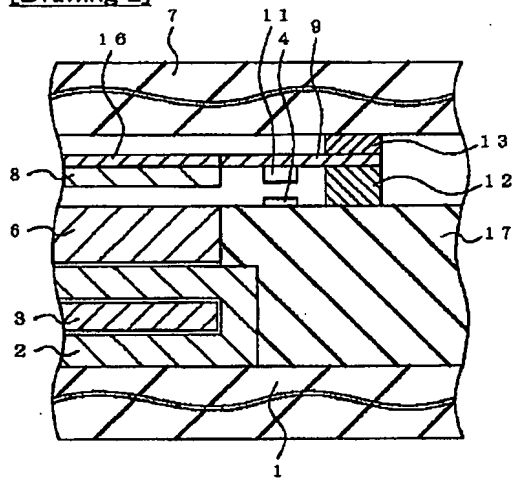
DRAWINGS

[Drawing 1]

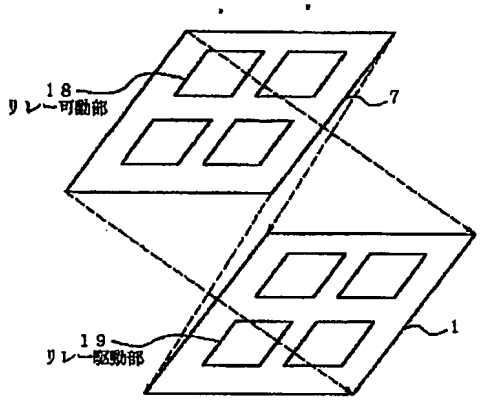


1，7：絶縁基板	10：可動接点ばね
2：コイル	11：可動接点
3：コア	12：ヒンジばね接続部
4：固定接点	13：ヒンジばね支持パッド
5：外部端子パッド	14：コイル端子
6：磁石	15：回転支持部
8：アマチュア	16：シリコン層
9：ヒンジばね	17：絶縁層

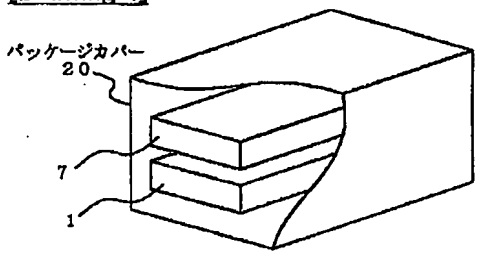
[Drawing 2]



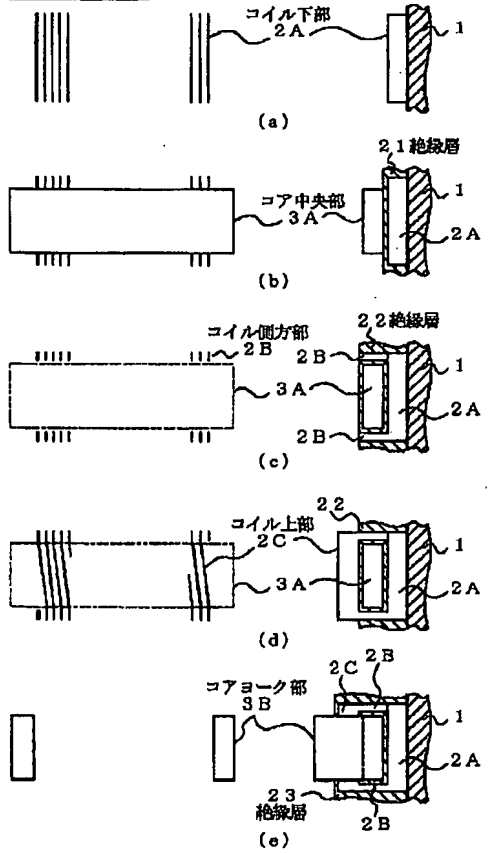
[Drawing 3]



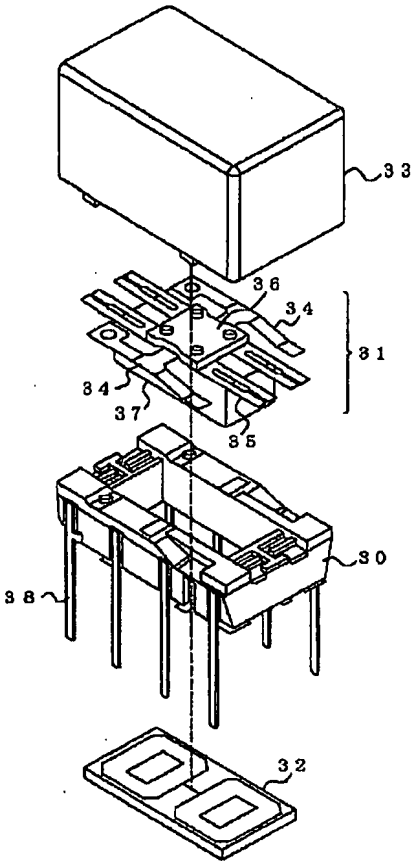
[Drawing 4]



[Drawing 5]



[Drawing 6]



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51/24		51/24	Ｒ	

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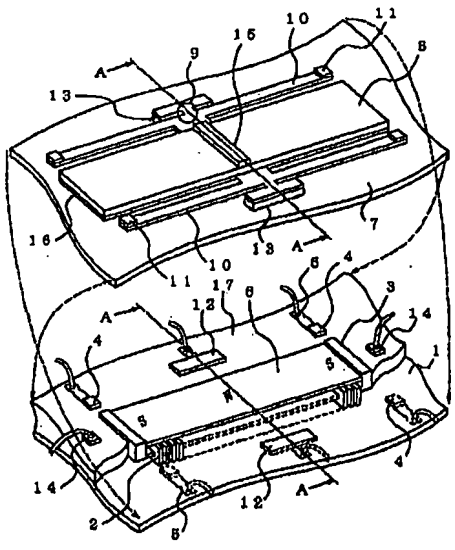
(54)【発明の名称】　電磁リレー及びその製造方法

(57)【要約】
【課題】実装スペースを小さくし高密度実装を可能にし、組立作業の簡略化やリレー特性の均一化を達成することにある。
【解決手段】コイル２，コア３，磁石６からなるリレー駆動部および固定接点４を積層形成した第１の絶縁基板１と、アマチュア８および可動接点１１を設けた可動ばね１０を備えるリレー可動部を積層形成した第２の絶縁基板７とを有し、第１，第２の絶縁基板１，７を向い合わせて形成される。



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【特許請求の範囲】

【請求項１】　コイル，コア，磁石からなるリレー駆動部および固定接点を一主面上に配置した第１の絶縁基板と、アマチュアおよび可動接点を設けた可動ばねを備えるリレー可動部を一主面上に配置した第２の絶縁基板とを有し、前記第１および第２の絶縁基板の前記一主面相互を向い合わせたことを特徴とする電磁リレー。

【請求項２】　前記第１および第２の絶縁基板は、前記リレー駆動部および前記リレー可動部をそれぞれ同数ずつアレー状に配置した請求項１記載の電磁リレー。

【請求項３】　前記第１および第２の絶縁基板は、カバーによってパッケージされる請求項１もしくは請求項２記載の電磁リレー。

【請求項４】　コ字型コアの中央部に設けられる複数の板状巻線部をスパイラル状に接続して形成されるコイルと，前記コイルに接続したコイル端子と，ヒンジばね用接続部と，固定接点と，前記ヒンジばね用接続部および前記固定接点に接続される外部端子パッドとを一主面上に配置した第１の絶縁基板と、回転支持部を設けたアマチュアおよび前記アマチュアに固定し且つ両端部に可動接点を備えた可動接点ばねをヒンジばねを介して固定するためのヒンジばね支持パッドを一主面上に形成した第２の絶縁基板とを有し、前記コアの側方部間に且つ前記コイルの上方に前記アマチュアのシーソバランスをバイアスするための磁石を配置し、前記第１および第２の絶縁基板の前記一主面相互を向い合わせたことを特徴とする電磁リレー。

【請求項５】　前記第１および第２の絶縁基板は、それぞれ複数のリレー可動部および前記リレー可動部と同数のリレー駆動部を備え、アレー状に配置した請求項４記載の電磁リレー。

【請求項６】　前記第１および第２の絶縁基板は、カバーによってパッケージされる請求項４もしくは請求項５記載の電磁リレー。

【請求項７】　第１の絶縁基板上にコイル底部，コア中央部，コイル側方部，コイル上部，コアヨーク部を順次形成し、固定接点およびヒンジばね接続部を形成してから磁石を搭載してリレー駆動部を含んだリレーベースを作成する工程と、第２の絶縁基板上にヒンジばね支持パッドおよび犠牲層を形成した後、前記犠牲層上にシリコン層および可動接点ばねを形成し、さらに前記シリコン層上にアマチュアを形成し、しかる後前記犠牲層をエッチング処理することにより、前記アマチュア，可動接点ばねを可動できるようにしてリレー可動部としてのコンタクトブロックを形成する工程と、前記第１の絶縁基板に前記第２の絶縁基板を対向させるように組付ける工程とを含むことを特徴とする電磁リレーの製造方法。

【請求項８】　第１の絶縁基板上に板状巻線下端部を形成するコイル底部作成工程と、前記板状巻線下端部の上に平坦化とともに絶縁してコア中央部を形成するコア中央部作成工程と、前記コア中央部に対して絶縁を保ちながら前記板状巻線下端部につづく板状巻線側方部を形成するコイル側方部作成工程と、前記コア中央部に対して絶縁を保ちながら且つスパイラル状になるように前記板状巻線側方部につづく板状巻線上端部を形成するコイル上部形成工程と、前記板状巻線の各部との絶縁を保ちながら前記コア中央部の両端にコアヨーク部を形成するコアヨーク部形成工程とを含み、前記第１の絶縁基板上に固定接点やヒンジばね接続部を形成しリレー駆動部を形成した後、前記コアヨーク部間に且つ前記板状巻線上端部の上方に磁石を配置し、アマチュアや可動ばねを備えたリレー可動部を形成した第２の絶縁基板を搭載することを特徴とする電磁リレーの製造方法。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】本発明は電磁リレー及びその製造方法に関し、特にシーソーバランス型磁気回路を有する電磁リレー及びその製造方法に関する。

【０００２】

【従来の技術】従来、このようなリレーは、実装する装置の小型化への要求、すなわち高密度実装の要求により、リレーそのもののサイズを小型化することが重要な要素の１つになっている。

【０００３】このような実装上の要求に対し、リレーを構成する各個片へのプレス加工の微細化やコイルの二重モールド成型によるデッドスペースの削減、あるいは磁石の高性能化によるコイル体積の削減などにより、リレーサイズの小型化が図られている。しかし、これらの製造方法あるいはリレー構造は、従来のリレー及びその製造方法の設計事項的な改良に過ぎず、さらなる小型化には限界がある。

【０００４】このため、リレーのさらなる小型化を狙って、リレーの製造に半導体プロセス技術を一部導入した構造も提案されている。このような提案は、例えば、リレー製造技術に関する国際学会誌「Ｐｒｏｃ．　４６ｔｈ　Ｒｅｌａｙ　Ｃｏｎｆ．１９９８」のｐ１４－１～ｐ１４－８に記載された“Ｔｈｅ　ＮＥＷ　Ｇｅｎｅｒａｔｉｏｎ　Ｔｅｌｅｃｏｍ　Ｒｅｌａｙ”などにも、有極シーソバランス動作形リレーとして紹介されている。

【０００５】図６は従来の一例を示す電磁リレーの分解斜視図である。図６に示すように、このリレーは、固定接点端子３８，コイル端子などを植設したキャリアと称される絶縁体基台３０と、可動接点ばね３５，ヒンジばね３４をベース部３６で固定するとともに、磁石３７を備えたリレー可動部３１と、リレー駆動部として平らに形成された平面状コイル３２と、全体を覆うカバー３３とを有し、絶縁体基台３０にリレー可動部３１と平面状コイル３２を装着してからカバー３３で覆って形成される。

【０００６】このリレーにおける可動接点系は、従来のプレス技術およびモールド加工等により、可動ばね３５，ヒンジばね３４，可動接点（可動ばね３５の先端に形成）およびこれらを支持するベース部３６を作成している。一方、駆動系は、同一面内にコイル線パターンが巻回される平面状コイル３２を半導体プロセス技術を用いて作成している。

【０００７】

【発明が解決しようとする課題】上述した従来の電磁リレーは、可動接点系を依然として機械加工技術により作成するため、一部に最先端技術を用いても、現状と同程度の寸法が限界になるという欠点がある。

【０００８】また、駆動系についてみると、動作磁界を確保するため、コイルを形成する基板の一層に多数回の巻線パターンを作成しなければならず、コイル占有面積を大きく必要とするという欠点がある。確かに高さ方向には小型化を図れるものの、全体としての実装スペースを小さくできないという問題がある。

【０００９】本発明の目的は、実装スペースを小さくし高密度実装を実現するとともに、組立作業の簡略化やリレー特性の均一化をも達成することのできる電磁リレー及びその製造方法を提供することにある。

【００１０】

【課題を解決するための手段】本発明の電磁リレーは、コイル，コア，磁石からなるリレー駆動部および固定接点を一主面上に配置した第１の絶縁基板と、アマチュアおよび可動接点を設けた可動ばねを備えるリレー可動部を一主面上に配置した第２の絶縁基板とを有し、前記第１および第２の絶縁基板の前記一主面相互を向い合わせて構成される。

【００１１】また、これら第１および第２の絶縁基板は、前記リレー駆動部および前記リレー可動部をそれぞれ同数ずつアレー状に配置して形成することができる。

【００１２】また、これら第１および第２の絶縁基板は、カバーによってパッケージ形成される。

【００１３】さらに、本発明の電磁リレーは、コ字型コアの中央部に設けられる複数の板状巻線部をスパイラル状に接続して形成されるコイルと，前記コイルに接続したコイル端子と，ヒンジばね用接続部と，固定接点と，前記ヒンジばね用接続部および前記固定接点に接続される外部端子パッドとを一主面上に配置した第１の絶縁基板と、回転支持部を設けたアマチュアおよび前記アマチュアに固定し且つ両端部に可動接点を備えた可動接点ばねをヒンジばねを介して固定するためのヒンジばね支持パッドを一主面上に形成した第２の絶縁基板とを有し、前記コアの側方部間に且つ前記コイルの上方に前記アマチュアのシーソバランスをバイアスするための磁石を配置し、前記第１および第２の絶縁基板の前記一主面相互を向い合わせて構成される。

【００１４】また、これら第１および第２の絶縁基板は、それぞれ複数のリレー可動部および前記リレー可動部と同数のリレー駆動部を備え、アレー状に配置して形成される。

【００１５】また、これら第１および第２の絶縁基板は、カバーによってパッケージ形成される。

【００１６】さらに、本発明の電磁リレーの製造方法は、第１の絶縁基板上にコイル底部，コア中央部，コイル側方部，コイル上部，コアヨーク部を順次形成し、固定接点およびヒンジばね接続部を形成してから磁石を搭載してリレー駆動部を含んだリレーベースを作成する工程と、第２の絶縁基板上にヒンジばね支持パッドおよび犠牲層を形成した後、前記犠牲層上にシリコン層および可動接点ばねを形成し、さらに前記シリコン層上にアマチュアを形成し、しかる後前記犠牲層をエッチング処理することにより、前記アマチュア，可動接点ばねを可動できるようにしてリレー可動部としてのコンタクトブロックを形成する工程と、前記第１の絶縁基板に前記第２の絶縁基板を対向させるように組付ける工程とを含んで構成される。

【００１７】さらに、本発明の電磁リレーの製造方法は、第１の絶縁基板上に板状巻線下端部を形成するコイル底部作成工程と、前記板状巻線下端部の上に平坦化とともに絶縁してコア中央部を形成するコア中央部作成工程と、前記コア中央部に対して絶縁を保ちながら前記板状巻線下端部につづく板状巻線側方部を形成するコイル側方部作成工程と、前記コア中央部に対して絶縁を保ちながら且つスパイラル状になるように前記板状巻線側方部につづく板状巻線上端部を形成するコイル上部形成工程と、前記板状巻線の各部との絶縁を保ちながら前記コア中央部の両端にコアヨーク部を形成するコアヨーク部形成工程とを含み、前記第１の絶縁基板上に固定接点やヒンジばね接続部を形成しリレー駆動部を形成した後、前記コアヨーク部間に且つ前記板状巻線上端部の上方に磁石を配置し、アマチュアや可動ばねを備えたリレー可動部を形成した第２の絶縁基板を搭載して構成される。

【００１８】

【発明の実施の形態】次に、本発明の実施の形態について、図面を参照して説明する。

【００１９】図１は本発明の一実施の形態を説明するための電磁リレー主要部を形成するリレー可動部とリレー駆動部の斜視図である。図１に示すように、本実施の形態における電磁リレーは、可動接点１１を有する可動接点ばね１０とこの可動接点ばね１０を駆動するシーソバランス型磁気回路を有するものであり、磁石６以外の各個片および組立を半導体プロセス技術、すなわち成膜技術を用いて製造するものである。特に、コイル２の巻線が一層の板状を成し、絶縁基板１の厚み方向に垂直な方向に巻かれるものである。なお、絶縁基板１は上面側を表わし、絶縁基板７は裏面側を表わしている。

【００２０】かかるリレーは、一方の絶縁基板１上にコ

イル２，コア３，固定接点４外部端子パッド５，磁石６を配置し、他方の絶縁基板７上にアマチュア８，ヒンジばね９，可動接点ばね１０，可動接点１１，ヒンジばね支持パッド１３を設けている。また、ヒンジばね９，可動接点ばね１０はシリンコン層１６と一体に形成されるため、これらには抵抗値を低くする目的で導体層（図示省略）を配置する。さらに、これら２つの絶縁基板１，７は対向接合することにより、きわめて薄いリレーを形成する。

【００２１】また、本実施の形態におけるリレーのコイル２は、コア３の周囲に１層分の板状巻線として施され、絶縁基板１の厚み方向に対して垂直な方向に絶縁層を介しながらスパイラル状（らせん状）に巻かれている。

【００２２】このため、本実施の形態は、従来のメカニカルリレーで知られている有極型シーソーバランス磁気回路において、半導体プロセス技術を採用することにより、コの字型コア３の異形化による磁気効率の向上、コア３の長手方向にコイル巻線を板状にすることによる体積の極小化、およびアマチュア構造の微細化を可能にしている。その結果、超小型リレーを実現することができる。

【００２３】具体的には、現在の最先端のプレス，モールド技術を駆使した有極型シーソーバランス磁気回路リレーでは、体積が０．５５立方ｃｍ（＝１０．６×５．８×９．０ｍｍ）程度のものが最も小形であるのに対し、本実施の形態によれば、体積が０．０７立方ｃｍ（＝６×４×３ｍｍ）のリレーを実現するこことができる。

【００２４】以上は、本実施の形態におけるリレーの概略について説明したが、要するに本実施の形態は、第１の絶縁基板１の一主面上に、コ字型コア３と，このコ字型コア３の中央部に設けられる複数の板状巻線部をスパイラル状に接続して形成されるコイル２と，これらコイル２やコア３の周囲に形成される絶縁層１７と，この絶縁層１７上に形成されるとともに、コイル２に接続したコイル端子１４と，ヒンジばね用接続部１２と，可動接点１１に対向配置させる固定接点４と，これらヒンジばね用接続部１２および固定接点４に接続される外部端子パッド５とを配置し、また第２の絶縁基板７の一主面上に、回転支持部１５を設けたアマチュア８およびこのアマチュア８に固定し且つ両端部に可動接点１１を備えた可動接点ばね１０をヒンジばね９を介して固定するためのヒンジばね支持パッド１３を形成する。しかも、コア３の側方部間に且つコイル２の上方にアマチュア８のシーソバランスをバイアスするための磁石６を配置し、２つの絶縁基板１，７の一主面相互を向い合わせることにより、リレーを形成している。

【００２５】図２は図１におけるヒンジばね近傍の拡大断面図である。図２に示すように、ここでは前述した導体層を省略しているが、リレー可動部のシリコン層１６がヒンジばね９や可動接点ばね１０と一体に作成される。なお、前述した犠牲層はシリコン層１６と絶縁基板７との空間に位置していたが、アマチュア８や可動接点ばね１０の回動運動を保証するためにエッチングによって除去されている。

【００２６】図３は本発明の他の実施の形態を説明するための電磁リレー可動部とリレー駆動部を模式的に表わした状態の斜視図である。図３に示すように、本実施の形態は、本実施の形態においては、前述の図１に示すアマチュアおよび可動接点を設けた可動ばねを備えるリレー可動部１８を一主面上にアレー状に配置した絶縁基板７と、前述の図１に示すコイル，コア，磁石や固定接点を設けたリレー駆動部１９をアレー状に一主面上に配置した絶縁基板１とを有し、これらの絶縁基板１，７の一主面相互を向い合わせたものである。なお、このアレー状の配置は、一列棒状に配置しても良く、また１つ１つ独立したリレーとして切り出しても良い。このように、１つの絶縁基板に多数個のリレーを形成すれば、より一層高密度実装が実現される。

【００２７】さらには、これら絶縁基板１，７上にダイオードやトランジスタを同時に形成するか、搭載することにより、スイッチ機能に加えて、電流や電圧の制御回路を実現することができる。

【００２８】図４は図１あるいは図３に示すリレーをパッケージ化した状態の一部切欠き斜視図である。図４に示すように、前述した２つの絶縁基板１，７を向い合わせ、１つもしくは複数のリレー機構部を形成したものをパッケージカバー２０によって覆うことにより、１つの電磁リレーもしくは電磁リレーアレーを形成することができる。

【００２９】また、かかるパッケージ化は、従来から行われているカバーと樹脂モールドによって実現することもできる。

【００３０】次に、本発明の電磁リレーの製造方法について、全体的な工程を前述した図１，図２を用いて説明し、ついでコイル，コアの具体的な製造工程を図５を参照して説明する。

【００３１】まず、図１，図２に示すように、リレー駆動部については、絶縁基板１上にアルミニウム（Ａｌ）等でコイル２の下部をエッチングまたはめっきなどにより形成し、その上に絶縁層を介しＦｅまたはＦｅ－Ｎｉなどの磁性体材料でコア３の胴体部を形成する。ついで、コイル２のサイド部を形成する。さらに、コア３の胴体部の上面に絶縁層を設けた後、コイル２の上部と、コア３のヨーク部を形成する。しかる後、上述した複数の絶縁層によって形成される絶縁層１７の上に固定接点搭載部，外部端子パッド５，ヒンジばね接続部１２を形成し、前記固定接点搭載部に固定接点４を被着する。さらに、コイル２の上部の上面に形成する絶縁層１７を掘

り込み、コア３のヨーク部の両磁極部間に磁石６を組付けてリレー駆動部を含んだリレーベースを作成する。

【００３２】また、リレー可動部については、もう一方の絶縁基板７上に、ヒンジばね支持パッド１３と、最終的にはエッチングなどにより除去される犠牲層とを形成する。かかる犠牲層は、支持パッド１３とは同一面にあり、しかもアマチュアや可動ばねなどが配置される領域に形成される。この犠牲層上には、シリコン（Ｓｉ）などによりシリコン層１６，可動接点ばね１０，アマチュア接合部（アマチュアと可動接点ばねの接合部分）が形成され、これらと一体にヒンジばね支持パッド１３上には、ヒンジばね９を積層形成する。さらに、可動接点１１から可動接点ばね１０を介し、ヒンジばね支持パッド１３まで、可動接点ばね１０の下側に、可動接点１１からヒンジばね９までの導通を確保するため、Ａｌ等で導体層（図示省略）を形成する。ついで、シリコン層１６の上に、ＦｅまたはＦｅ－Ｎｉなどの磁性体材料でアマチュア８を積層形成する。さらに、可動接点ばね１０の先端に可動接点１１を形成する。その後、犠牲層をエッチング処理し、アマチュア８，可動接点ばね１０を可動できるようにして、リレー可動部としてのコンタクトブロックを形成する。

【００３３】さらに、ベース側絶縁基板１にコンタクト側絶縁基板７を対向させるように組付けた後、外部端子接続パッド５に配線を行う。なお、この配線は両基板１，７の組付け前であっても良い。

【００３４】以上は、本実施の形態における電磁リレーの全体的な製造工程であり、以下にコイル，コアの具体的な製造工程を説明する。

【００３５】図５（ａ）～（ｅ）はそれぞれ本発明の電磁リレーの製造方法の一実施の形態を説明するための工程順に示したコイル，コアの上面および側断面を表わす図である。まず、図５（ａ）に示すように、コイル底部作成工程では、絶縁基板１上にＡｌなどで所定の寸法にコイル下部２Ａを形成する。この場合、所定の寸法はコイル抵抗，感動電圧，発生磁界量によって決定される。その形成方法は、予め薄膜のパターンを形成しておくが、この外にもめっきやスパッタにより所定の厚みに形成しても良い。また、このコイル下部２Ａは、コイルの作成範囲全体に所定の厚みのコイル材料を成膜しておき、エッチングによって不要部分を除去しても良い。

【００３６】ついで、図５（ｂ）に示すように、コア胴体部作成工程では、コイル下部２Ａとコア中央部３Ａの絶縁を確保するため、二酸化シリコンなどの絶縁層２１でコイル下部２Ａを覆った後、その絶縁層上で且つコイル下部２Ａの上方に蒸着，スパッタなどの方法を用い、ＦｅまたはＦｅ－Ｎｉなどの磁性体材料でコア中央部（胴体部）３Ａを形成する。

【００３７】ついで、図５（ｃ）に示すように、コイル側方部作成工程では、コイルとコアの絶縁を同様に確保するため、図５（ｂ）で形成したコア中央部３Ａを絶縁層２１と同様の絶縁層２２で一旦覆う。その後、コイル下部２Ａからコイル側方部２Ｂを同一材料で成長させるため、コイル下部２Ａを覆う絶縁層２１の一部をエッチングにより剥離し、その剥離した個所にコイル側方部２Ｂをコイル下部２Ａと同一の方法で形成する。

【００３８】しかる後、図５（ｄ）に示すように、コイル上部形成工程では、コイル側方部２Ｂに引き続き、コイル上部２Ｃを同様の方法で形成する。

【００３９】さらに、図５（ｅ）に示すように、コアヨーク部形成工程では、コイルと磁石の絶縁を確保するため、コイル上部２Ｃを絶縁層２３で覆う。その後、コア中央部３Ａの両端からコアヨーク部３Ｂを成長させるため、コア中央部３Ａの両端を覆っている絶縁層２１，２２の一部をエッチングにより剥離し、コアヨーク部３Ｂをコア中央部３Ａと同様の方法で形成する。この後、コアヨーク部３Ｂ間に別途作成した磁石を配置する。この磁石はコストや性能等を考慮し、バルク部品として後付けする方法を取ったが、もちろん蒸着およびエッチング等の成膜技術を用いて作成しても良い。

【００４０】以上は、絶縁基板１側に形成されるリレー駆動部の主要部分となるコイル，コアの製造工程であるが、絶縁基板７側に形成されるリレー可動部については、前述の図１，図２を用いて説明したように形成しても良く、または別途独立して形成することもできる。

【００４１】

【発明の効果】以上説明したように、本発明の電磁リレー及びその製造方法は、リレー可動部とリレー駆動部をそれぞれ別の絶縁基板に積層形成し、それらを対向配置させることにより、薄型で且つサイズを小型化できるという効果がある。

【００４２】また、本発明は、各絶縁基板に同数のリレー可動部とリレー駆動部を配置することにより、高密度実装を実現できるという効果がある。

【００４３】さらに、本発明は、コイルを１層の板状にした複数のコイル部分をスパイラル接続するとともに、コイルおよびコアを半導体成膜技術を用いて形成することにより、組立作業を簡略化でき、リレー特性を均一化できるという効果がある。

【図面の簡単な説明】

【図１】本発明の一実施の形態を説明するための電磁リレー主要部を形成するリレー可動部とリレー駆動部の斜視図である。

【図２】図１におけるヒンジばね近傍の拡大断面図である。

【図３】本発明の他の実施の形態を説明するための電磁リレー可動部とリレー駆動部を模式的に表わした状態の斜視図である。

【図４】図１あるいは図３に示すリレーをパッケージ化した状態の一部切欠き斜視図である。

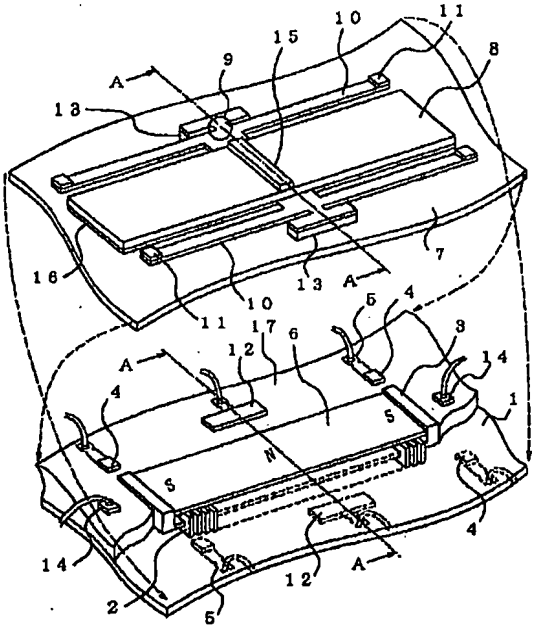
【図５】本発明の電磁リレーの製造方法の一実施の形態を説明するためのコイル，コアの上面および側断面を工程順に表わした図である。

【図６】従来の一例を示す電磁リレーの分解斜視図である。

【符号の説明】

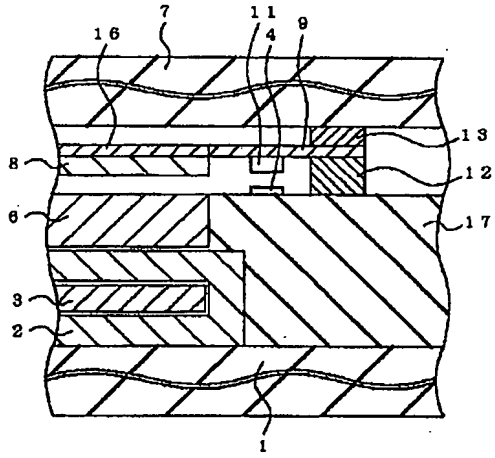
１，７　絶縁基板
２　コイル
２Ａ　コイル下部
２Ｂ　コイル側方部
２Ｃ　コイル上部
３　コア
３Ａ　コア中央部
３Ｂ　コアヨーク部
４　固定接点
＊５　外部端子パッド
６　磁石
８　アマチュア
９　ヒンジばね
１０　可動接点ばね
１１　可動接点
１２　ヒンジばね接続部
１３　ヒンジばね支持パッド
１４　コイル端子
１５　回転支持部
１６　シリコン層
１７，２１，２２，２３　絶縁層
１８　リレー可動部
１９　リレー駆動部
＊２０　パッケージカバー

【図１】

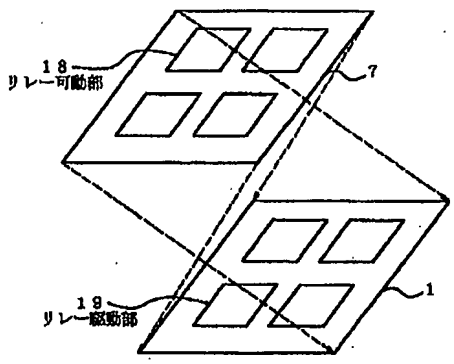


１，７：絶縁基板　１０：可動接点ばね
２：コイル　１１：可動接点
３：コア　１２：ヒンジばね接続部
４：固定接点　１３：ヒンジばね支持パッド
５：外部端子パッド　１４：コイル端子
６：磁石　１５：回転支持部
８：アマチュア　１６：シリコン層
９：ヒンジばね　１７：絶縁層

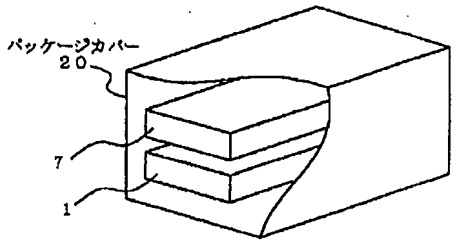
【図２】



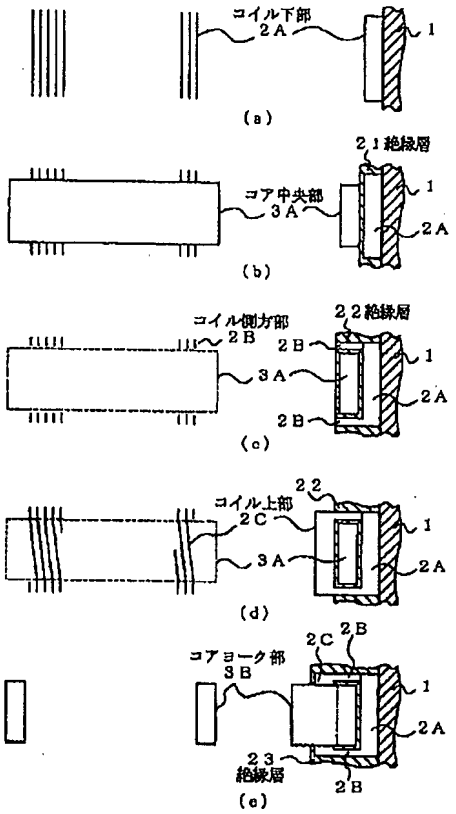
【図３】



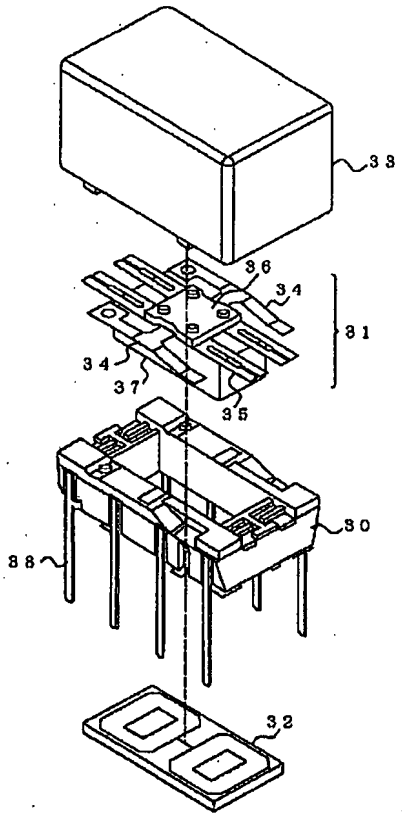
【図４】


パッケージカバー
２０
７
１

【図５】


コイル下部
２Ａ
１
(a)
２１絶縁層
コア中央部
３Ａ
１
２Ａ
(b)
コイル側方部
２Ｂ
２２絶縁層
２Ｂ
１
３Ａ
２Ａ
２Ｂ
(c)
２２
コイル上部
２Ｃ
１
３Ａ
２Ａ
(d)
２Ｃ
２Ｂ
コアヨーク部
３Ｂ
１
２Ａ
２３
絶縁層
２Ｂ
(e)

【図６】


３３
３６
３４
３１
３４
３７
３５
３０
３８
３２